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SPACE POWER SYMPOSIUM (C3)
Space-Based Solar Power Architectures – New Governmental and Commercial Concepts and Ventures (1)

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IMPLEMENTATION ARCHITECTURE FOR INDUSTRIAL-SCALE SPACE SOLAR POWER

Abstract

All scenarios to meet humanity's future energy needs are highly disruptive. Potential impacts include accelerating environmental damage, fundamental changes in land use, abrupt geopolitical shifts, social upheaval, and even economic collapse. Disruption cannot be avoided, but might be guided. Some geopolitical shifts, and some land-use changes, would be preferable to others. Requiring a solution to be sustainable begins to guide options. And space solar power holds the potential to avoid the worst disruptive scenarios. Perhaps as important, it holds even more potential: to open an era in which sustainable, abundant electricity enables not just grid power day and night around the globe, but also ample clean water and hydrogen-powered mobility. Emplacing enough industrial-scale space solar power to enable such an era would be a macro-engineering challenge on the scale of the Manhattan Project for the 1940s, or putting men on the Moon for the 1960s, or building the U.S. National Highway System throughout the 20th century. It would require a national or multi-national imperative; investment by a network of public-private partnerships; chartered cooperation by multiple government agencies, and decades to be demonstrated, developed, scaled up, and made essential. However, nations and enterprises that succeeded in accomplishing it would become the world's energy exporters forever. Because the resource is located in space, NASA could play a role to enable, or even shape, such an SPS future for the U.S. and the world. The significance of the undertaking – certainly in the scale of challenge, not to mention in its legacy for human civilization – might come to be seen by today's world as a worthy successor to Apollo. SPS could be the "Big Idea" NASA has struggled to find. Invented in the 1970s, SPS architectures are now engaged in a third generation of concept ideation. Implementation based on gossamer reflector arrays, hyper-modular solid-state conversion-transmission elements, retrodirective phased-array microwave steering, and robotic in situ operations would appear to be lighter, simpler, and more scaleable than previous-generation concepts imagined. Study work has commenced that leverages the third-generation SPS architecture concepts. Most current work concentrates on SPS space system configurations and staged demonstration roadmaps. This paper frames an integrated conceptual treatment of industrial-scale SPS including: terrestrial demand scenario; ground-system, GEO, and transportation architectures; build-up and steady-state operations scenarios; and program implementation scenario. The quantitatively coherent analysis portrays what full-up implementation might look like, yields salient insights to inform planning, and highlights next-step analyses.